the star is from two to three magnitudes fainter on the photographs. There are several small stars near, and on the night of November 19 their magnitudes were roughly estimated. The star is found on three of Dr. Wolf's photographs that he has kindly sent me. The third photograph is not dated, but, I believe, was taken in the beginning of November. The following are the magnitudes taken from the photographs:

1891 June 1	10·8
September 9 and 10	11·2
November	10·0

On November 19 the star was estimated as 7·6, and on November 26 as 7·8.

Tow Law, Darlington:
1891 *December* 9.

Note on the Stonyhurst Drawings of the Solar Spots and Faculæ.
By the Rev. Walter Sidgreaves.

At the commencement of the series of Sun-spot drawings, instituted by the late Fr. Perry in November 1880, it was decided to fill in the faculæ, so far as this could be done with certainty. No small difficulty was experienced in the attempt, for it seemed impossible to produce a faithful representation of them, and both the director and the observer were forced to be content with a skeleton tracing of the brighter parts which could be differentiated from the rest of the photosphere without chance of error. Experience, however, in the course of time, taught the observer the magic effect of motion imparted to a faint image; and as he slowly travelled the image of the Sun across the drawing-sheet, the patches stood out with a clearness of definition that excluded all doubt of the border-line between faculæ and photospheric glare. The method then adopted, and followed ever since, was first to outline the brighter parts upon the stationary image, and then to fill in the picture by sketching the fainter details taken from the image while moving it slowly to and fro across the paper. By this means a very trustworthy record was obtained; and it was much improved by adopting the suggestion, made by Sir G. Stokes in 1883, that the contrast of a red-lead tracing of the faculæ would greatly help the eye in its search through the drawings for the true relation between the dark spots and their glowing attendants. This is apparent in following the disturbances through all their changes, and in sifting their evidences for an answer to the query, Which is the forerunner of the other?

During the entire period of Fr. Perry's direction of this observatory no clear instance of faculæ preceding the birth of a spot had been detected in the drawings. Faculæ were always most abundant after the birth of a spot, and always outlived it, lingering for weeks and sometimes for months before expiring. But, on the other hand, the drawings afford no positive evidence of the birth of a spot before the appearance of faculæ; while every spot of importance appears to have been attended from the beginning with at least a small surrounding of faculæ. So that, although it remains true that faculæ in no extensive form precede the birth of a spot, but develop and grow to maturity either along with the spot or after its decline, we must guard our conclusions against their extension to the absolute priority of the spot.

The chances of gaining the positive evidence about the priority are not favourable. The greater part of the Sun's surface, on which a spot may spring into life, offers no possibility of seeing the faculæ. And during the years of greater activity our chances are greatly reduced by the interlacing of old and new faculæ. It is only during the minimum period of spot-life, when the intervals are greater and old *débris* get cleared away before new storms begin, that we can well hope for the evidence we want.

The drawings of the recent minimum period of 1889 have been under careful study during the past twelve months, and we find amongst them two cases in which the evidence of first appearance is unquestionable. And both of these show faculæ before any trace of a spot appears.

On June 29 a small patch of faculæ was sketched near the eastern limb, in latitude $-40°\cdot5$ and in longitude 252°. There was no trace of a spot in the neighbourhood, and neither spot nor faculæ had been seen near the position for years. On the following day a small round spot appeared in latitude $-40°\cdot3$ and longitude $252°\cdot2$—*i.e.*, in the midst of the faculæ, the faculæ on this day being visible only just close round the spot. Again, on July 31, another small patch of faculæ appeared in latitude $-22°$, longitude 155°, without any spot near it. It was seen again on the following day, and still without a spot. But on the third day, August 2, a spot was sketched in latitude $-21°\cdot9$, longitude $155°\cdot4$.

In both cases the faculæ were of small area, but bright. And there can be no doubt either of the faculæ or of the spots. Both were new. The faculæ were not remnants, and the spots were not revivals of old disturbances. We may not be able yet to conclude that faculæ are really forerunners of spots. The two spots referred to may have been for the time hidden from our view by the faculæ. But this has no appearance of probability, the faculæ being seen at a distance from the limb of quite one-tenth of the solar diameter. So far, therefore, as our drawings at these dates are witnesses to priority, their evidence stands for

some faculæ preceding the birth of a spot. And more of the same class of evidence may be found even in the years of greater spot frequency, when the records of their spots and faculæ have been more fully examined and the history of each group is more accurately written.

Stonyhurst Observatory,
Lancashire.

On the Determination of Azimuth by Elongations of Polaris.

By Harold Jacoby, B.A.

When Polaris has been observed within half an hour of elongation for the determination of azimuth, the "reduction to elongation" is frequently computed by the formulæ:

$$m = \frac{2 \sin^2 \frac{1}{2}(t_e - t)}{\sin 1''}$$

$$a_e - a = a_e \,.\, m \,.\, \sin 1''$$

where

t_e, a_e, are the hour angle and azimuth of *Polaris* at elongation,

t, a, ,, ,, ,, ,, the observation,

a_e and a being reckoned in seconds of arc, from the north point.

But we can avoid the use of the somewhat extended table for m by tabulating $a_e - a$ itself. For if we put

$$\mathrm{M} = 6000 \sin 1'' \cdot m$$

$$f = \frac{a_e - 6000}{6000}$$

we shall have

$$a_e - a = \mathrm{M} + f\mathrm{M}$$

Table I. gives M, with the argument $t_e - t$; and Table II. gives f with the argument a_e. It will be seen that M is really an approximate value of $a_e - a$, and f a correction factor for M. This factor can be multiplied by M with Crelle's Tables, so that logarithms will not be required.

Table III. gives the values of a_e and t_e for all latitudes between 35° and 55°. It is intended to take the place of the logarithmic calculation of a_e and t_e, or at least to serve as a check. The columns headed A and T are computed with the declination 88° 45′ 0″, and furnish approximate values of a_e and t_e. The columns headed x and y give the variations, per second of δ, of the azimuth and hour angle. We shall have, therefore,

$$a_e = \mathrm{A} + x(\delta - 88°\,45')$$

$$t_e = \mathrm{T} + y(\delta - 88°\,45')$$